Proceedings of the 5th International Conference of Fluid Flow, Heat and Mass Transfer (FFHMT'18)
Niagara Falls, Canada – June 7 – 9, 2018
Paper No. 124
DOI: 10.11159/ffhmt18.124

Simulation of Conjugate Heat Transfer in Plate Heat Exchanger with Chevron Shape

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Extended Abstract

This paper investigates the internal flow and heat transfer in chevron shaped plate heat exchanger with the conjugate heat transfer model developed by commercial computational fluid dynamics (CFD) software. This chevron plate heat exchanger consists of a stack of corrugated plates in mutual contact, and hot and cold channels are positioned between the intermediate chevron solid plates. The chevron plate has been studied for proper experimental correlations of heat transfer and pressure drop [1, 2], the design optimization of chevron plate [3] and numerical simulation of small sized plate [4]. And, two types of welded plate heat exchanger are examined by CFD analysis [5]. The turbulent model and wall function of chevron plate are suggested by comparing several turbulent models [6]. The purpose of this study is to describe heat transfer in detail, considering conjugate heat transfer between fluid and solid domains through the chevron plate. The fluid domain includes hot and cold channel, and the solid domain similarly contains solid chevron plates. As the internal flow and heat transfer in the chevron plates is not easily converged in the CFD solving process, the practicable conjugate heat transfer model are required and developed. The corrugated plate with 14 chevron shapes is designed for sufficient length. Each fluid and solid domain is properly meshed by grid independent test. The working fluid is water and counter flow configuration is adopted. The CFD model is simulated in Reynolds number range from 1,000 to 9,000 by CFD analysis with Realizable k-ε model. The distributions of temperature and surface heat transfer coefficient are displayed as simulation result in Fig. 1. The average heat transfer coefficient and Nusselt number calculated from CFD analysis are compared with the various empirical correlation data [1] in Fig. 2.

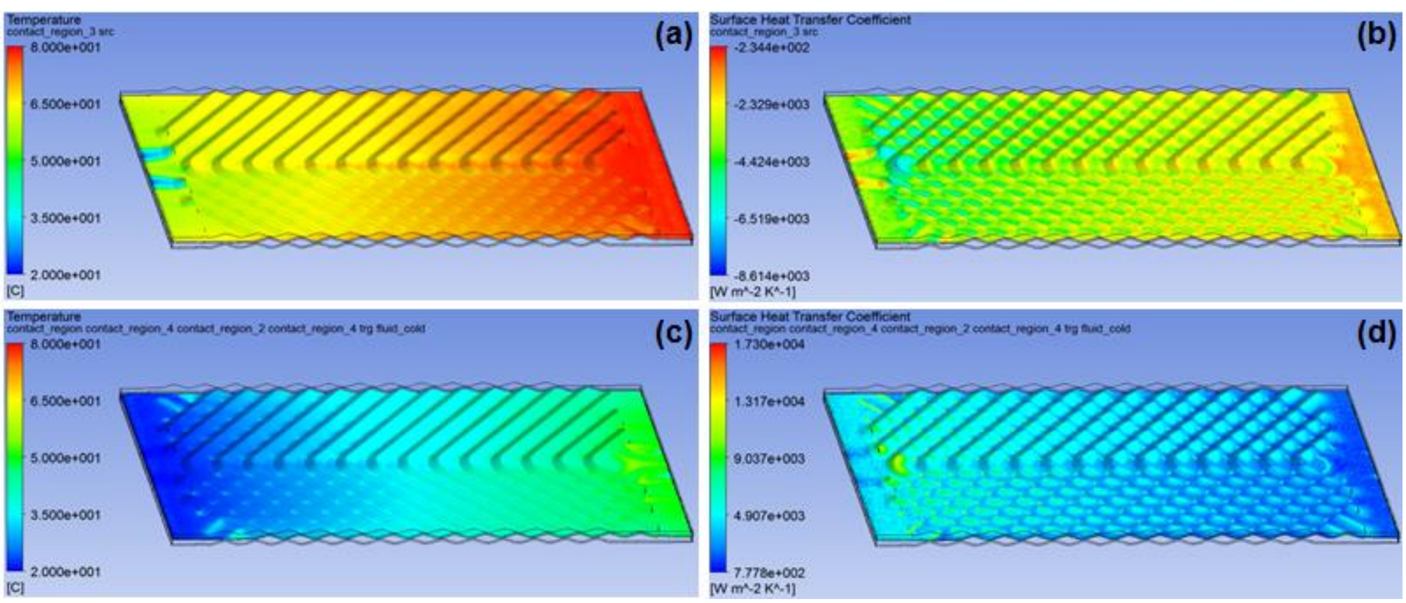

Fig. 1: Temperature and Surface heat transfer coefficient on chevron plates; (a,b) in hot channel, (c,b) in cold channel.

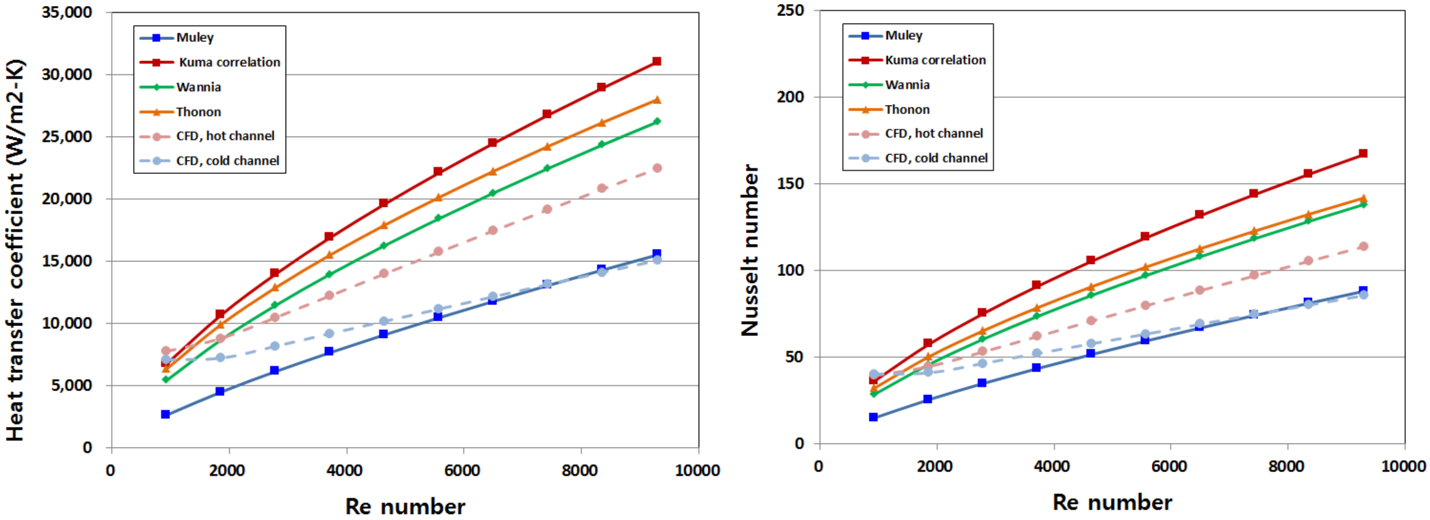

Fig. 2: Heat transfer coefficient and Nusselt number vs Reynold numbers.

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